THE WEATHER AND CIRCULATION OF AUGUST 1965

A Cool Month

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1. INTRODUCTION

Unusually low temperatures prevailed over most of the United States in August in response to a blocking circulation pattern in western Canada and a deep trough over eastern North America. While daily temperatures fell at times below previously recorded August extremes in the East, only one new temperature record was established for the month as a whole, at Brownsville, Tex. One reason for the lack of monthly extremes was a temporary interruption of the cool blocking regime the second week when a subtropical ridge developed and migrated eastward from the West. At the peak of the ensuing heat wave, temperatures were the highest of record for August in South Dakota.

Rainfall of more than normal amounts and on more days than usual helped to lower temperatures in the West and Great Lakes Region. Parts of the Great Plains and the Northeast were also wetter than usual, including some inland sections of the Northeast drought area.

August was the third consecutive month with predominantly negative temperature departures; therefore the summer average was below normal except in a few small areas. During the period of available seasonal records beginning with 1933, only the summer of 1950 has been comparably cool.

2. CIRCULATION

Extensive blocking in the Polar Region is reflected in several features of the average 700-mb. circulation for August (fig. 1) and its anomaly (fig. 2). Over the Arctic Ocean the circulation was generally anticyclonic with positive height departures, encircled by four Polar Lows instead of the usual two, all with substantial anomaly centers within the surrounding negative band. Another region of blocking appeared over western Canada where positive height anomalies centered in the mean ridge extended across the Gulf of Alaska. The Low and trough in eastern Canada were extremely intense (−280 ft.) and negative anomalies associated with it extended across the United States.

Wavelengths south of the Polar Basin were short and at least one more wave than normal was observed in the latitude bands south of 70° N. Deep troughs affiliated with the Polar Lows extended well into temperate latitudes but not into the Tropics. The complex wave pattern included additional mid-latitude troughs across China, the eastern Pacific, and the eastern Mediterranean, all out of phase with ridges farther north. Subtropical ridges were stronger than usual over the central Atlantic, the Caspian Sea, and the western Pacific.

Compared with July [1], positive height departures were considerably reduced in the Siberian Arctic but increased in Alaska and Canada. In the high-latitude wave train an adjustment from July to August was made necessary by excessive wavelength between the stationary Low over Baffin Island and the eastward-migrating Low near Spitzbergen. This was accomplished by the development of a new trough and Low near Iceland.

The axis of maximum wind speed at 700 mb. (fig. 3) was south of normal across Asia and the Pacific, except for one branch which curved northward from mid-Pacific around the blocking ridge over Alaska and Canada and retained its anomalous northward displacement through the very deep trough in eastern Canada. Wind speeds between this trough and the strong Atlantic ridge averaged up to 16 m.p.s. for the month east of Newfoundland.

3. MONTHLY WEATHER

Negative temperature anomalies over most of the United States (fig. 4) were associated with unusually strong southward advection of Canadian air between the blocking ridge in western Canada and the deep trough farther east. Lowest temperatures occurred early in the month (Michigan) and the last week (Illinois to New England to North Carolina).

Coolness west of the Divide was not as well indicated by the mean circulation. Temperatures averaged higher than normal in parts of the Pacific Northwest and the Southwest where there was a southerly component of mean flow and height departures were generally positive. An important cooling factor was frequent precipitation of unusually large amounts.

It was much wetter than usual in much of the West (table 1 and fig. 5) where southwesterly flow from a trough off the coast was lifted orographically. August rainfall

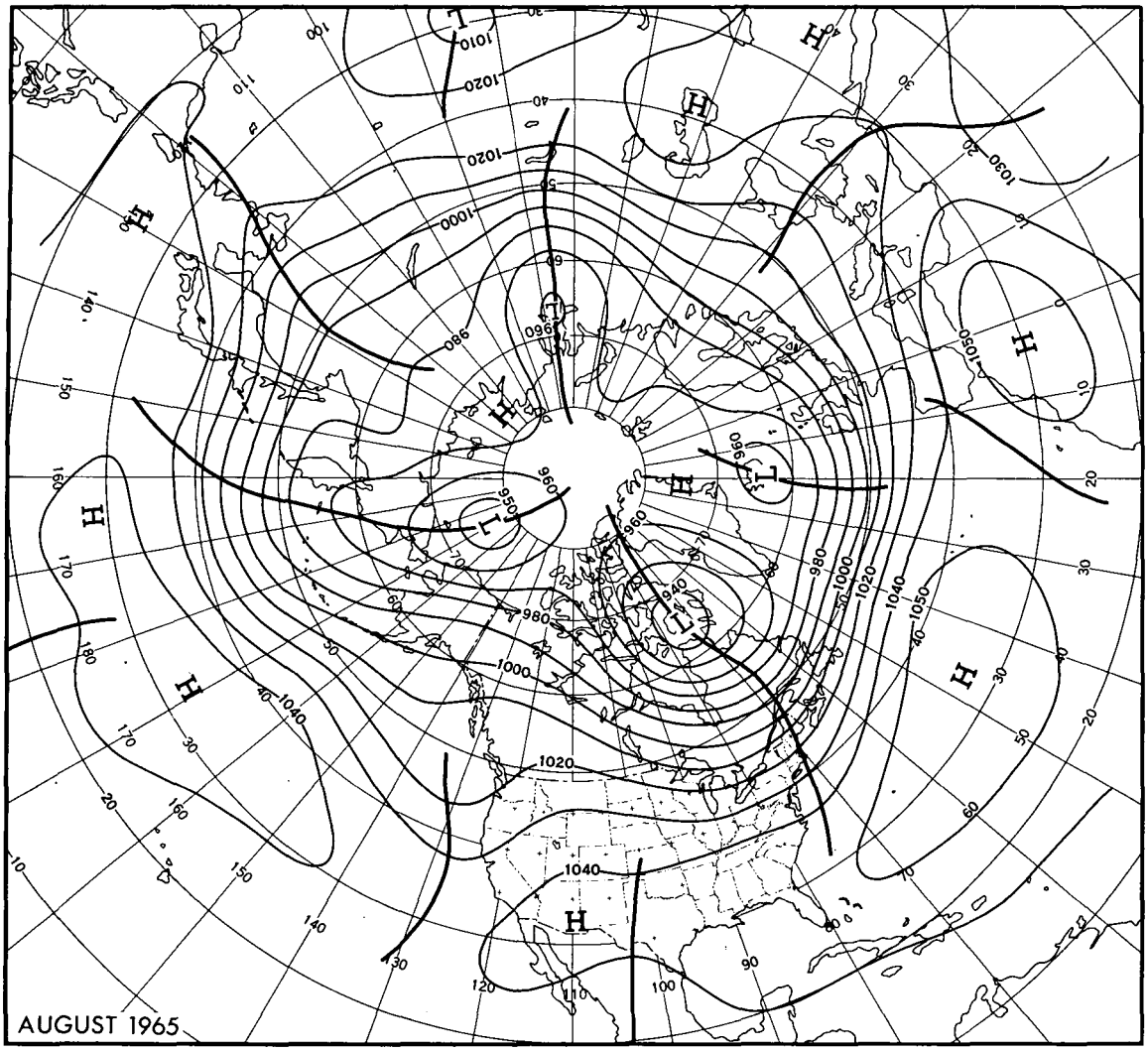


FIGURE 1.—Mean 700-mb. contours (tens of feet), August 1965.

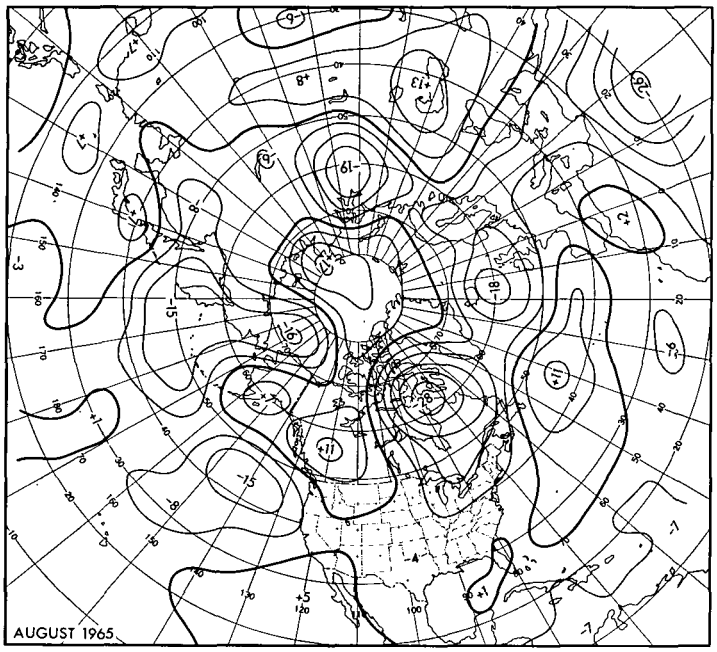


FIGURE 2.—Departure of mean 700-mb. heights from normal (tens of feet), August 1965.

there is so light, however, that accumulations ranging from 1 to 2 in. were two to five times the normal amounts. Rainfall east of the Rocky Mountains was irregularly distributed but generally greater than normal in the cyclonic mean flow over the Great Lakes Region and the Northeast. Toledo, Ohio had 8.5 in., the most August precipitation of record and Peoria, Ill., was wetter only in August 1862. While the drought situation was made somewhat less serious in parts of the Northeast, the coast

TABLE 1.—*Cities with most August precipitation of record in 1965*

City	Amount	Departure from Normal
Stockton, Calif.	0.35	+0.35
Boise, Idaho	0.88	+0.72
Kalispell, Mont.	3.47	+2.38
Reno, Nev.	1.65	+1.48
Meacham, Oreg.	4.89	+4.36
Medford, Oreg.	1.52	+1.34

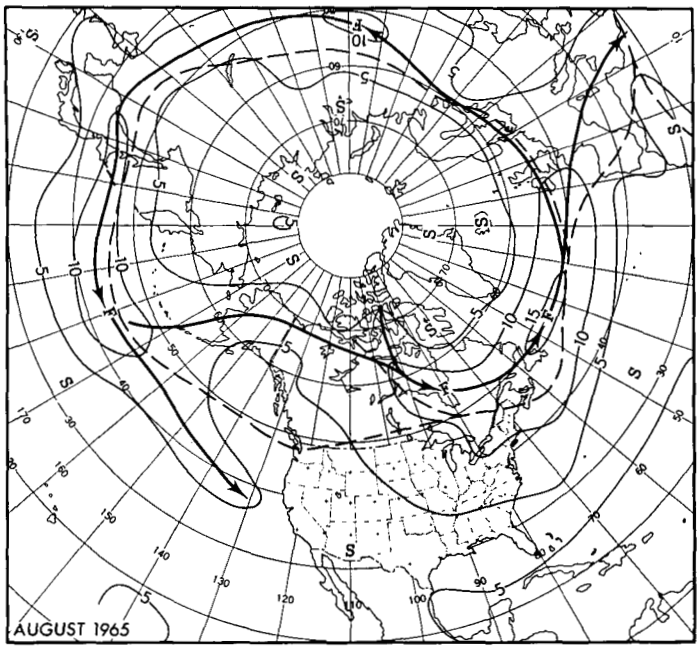


FIGURE 3.—Mean 700-mb. isotachs (meters per second), August 1965. Solid arrows indicate principal axes of maximum wind speed and dashed lines the normal.

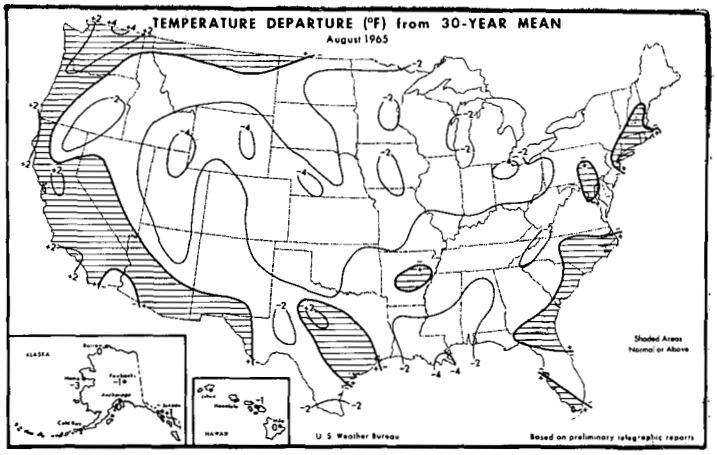


FIGURE 4.—Temperature departure (°F.) from 30-yr. mean, August 1965 (from [2]).

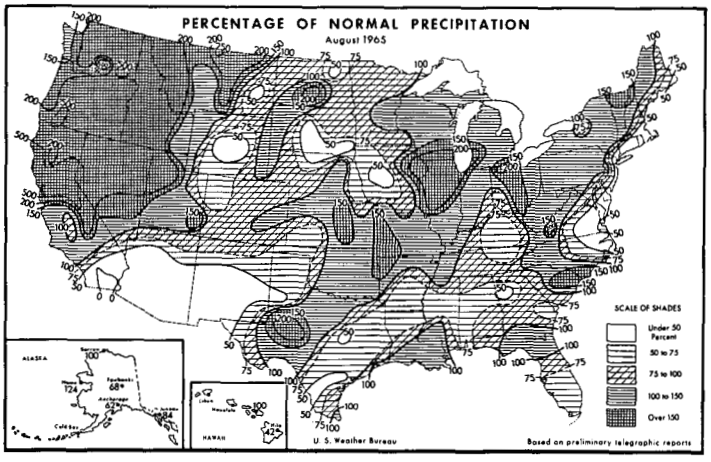


FIGURE 5.—Percentage of normal precipitation, August 1965 (from [2]).

remained dry. Frontal activity following the mid-month heat wave accounted for a large part of the precipitation in the Central and Southern Plains. Generally subnormal amounts were reported beneath the mean subtropical ridge over the Rocky Mountain States.

4. WEEKLY CIRCULATION AND WEATHER

AUGUST 2–8

During the first week the circulation over North America resembled the mean for the month (figs. 6A, B, and 1, 2) with a blocking ridge in western Canada, relatively weak westerly flow over western United States, and negative height departures over most of the Country. The trend was toward flattening of the extreme amplitude of late July.

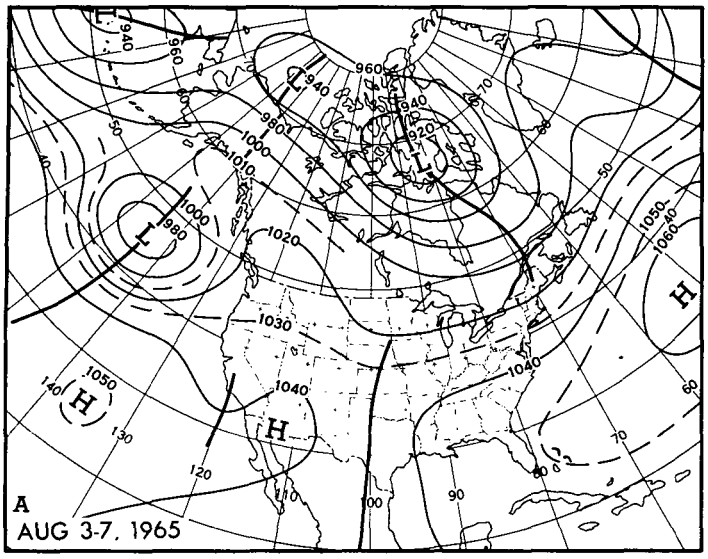
Temperatures averaged mostly below normal (fig. 6C), with negative anomalies of more than 6° F. in Nebraska and near the southern end of the Appalachian Mountains. Scattered daily temperature records were broken the first three days from Missouri to Pennsylvania and Texas to Mississippi. Lansing, Mich. was the coldest of record for August on the 3d and damaging frost was reported in the lowlands nearby.

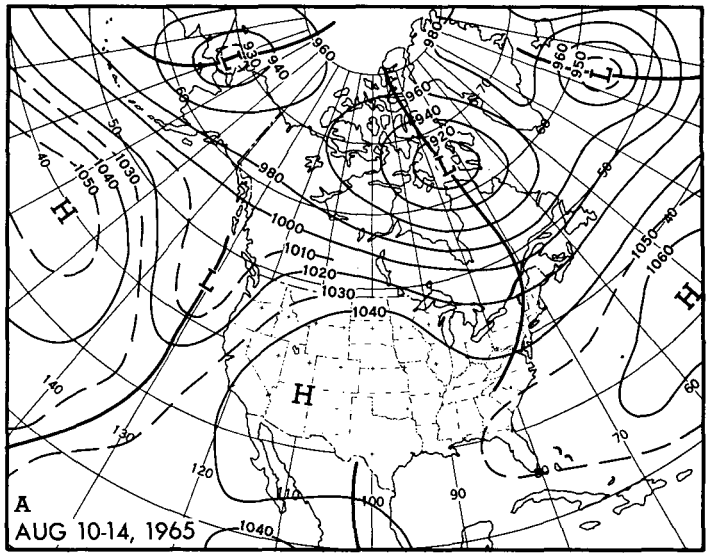
A series of frontal waves brought accumulations of more than 2 in. of rain locally acrosss the Northern Plains and the Great Lakes Region. Like amounts were also reported from showers along the Gulf Coast and parts of the Ohio and Tennessee Valleys.

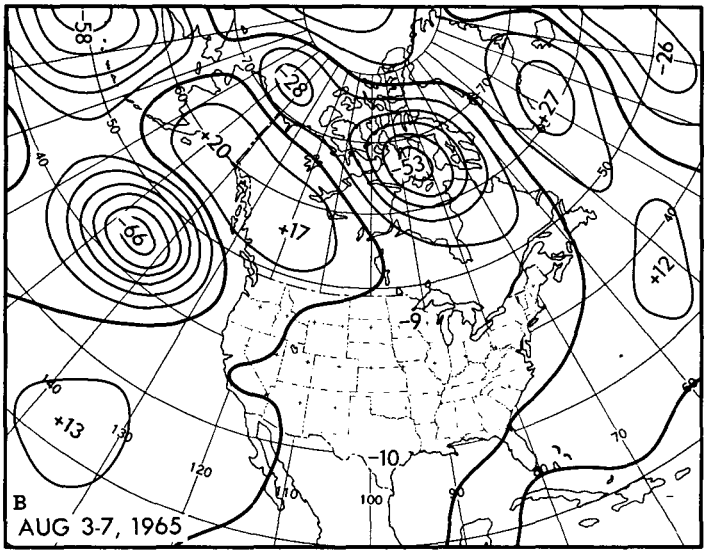
AUGUST 9–15

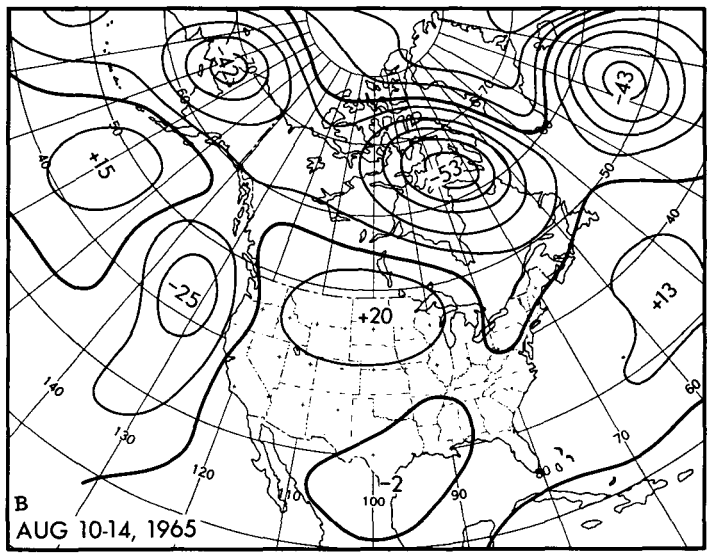
By the second week blocking had relaxed in western Canada and eastward motion was apparent. Troughs in the eastern Pacific and eastern States weakened while the western ridge strengthened as it shifted to the Northern Plains (figs. 7A, B). This brought a heat wave from the Far West across the North Central States and general warming over the Country, except in the Southern Plains. At Los Angeles, Calif. the temperature averaged 10° F. higher than the previous week (fig. 7C). On the 13th the highest August temperatures of record were reported at Aberdeen (112° F.) and Huron (110° F.), S.Dak., and by the weekend record daily maxima had been exceeded as far east as West Virginia.

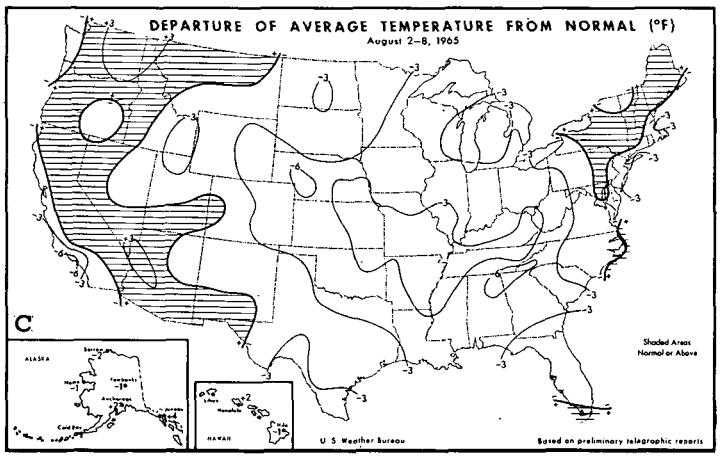
As the circulation became more anticyclonic over the United States the principal storm track shifted north of the Canadian border and precipitation decreased from the previous week in the Northern Plains and Great Lakes area. Rainfall increased in the West and the Northeast











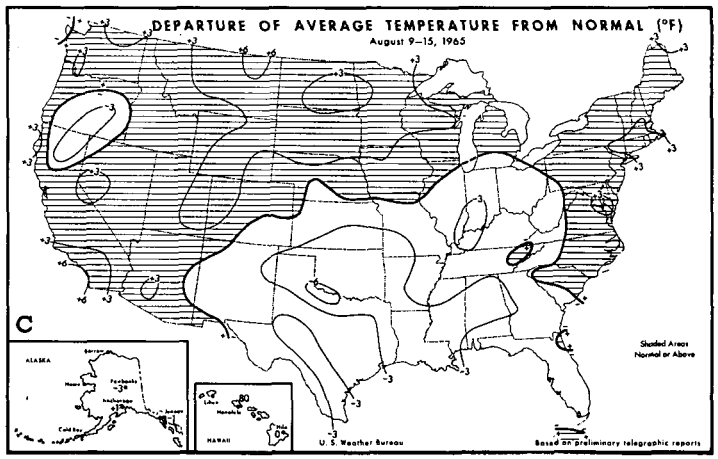
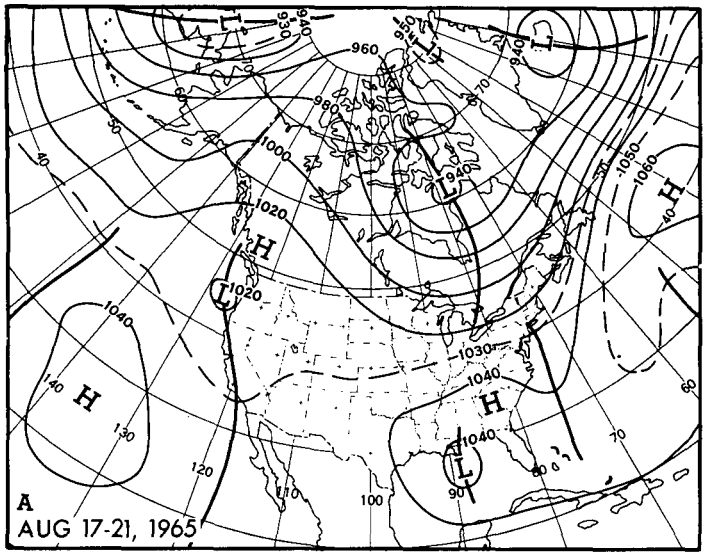
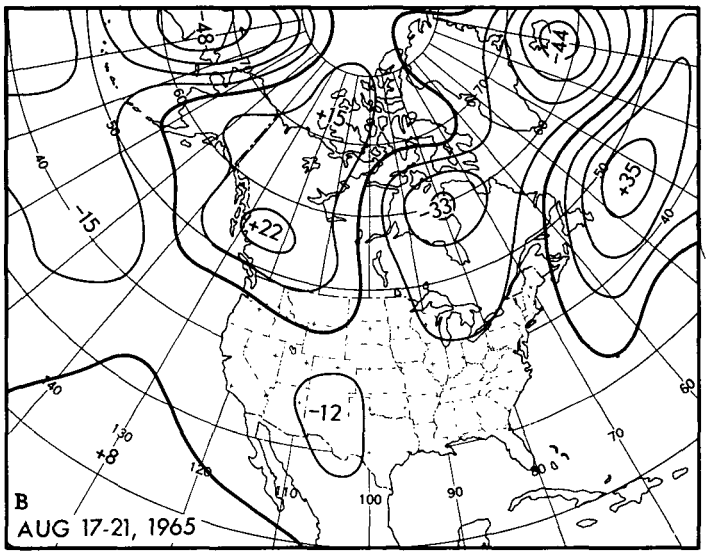


FIGURE 6.—(A) Mean 700-mb. contours and (B) height departures from normal, both in tens of feet, for August 3–7, 1965; (C) departure of average temperature from normal (°F.), August 2–8, 1965 (from [2]).

FIGURE 7.—(A) Mean 700-mb. contours and (B) height departures from normal, both in tens of feet, for August 10–14, 1965; (C) departure of average temperature from normal (°F.), August 9–15, 1965 (from [2]).





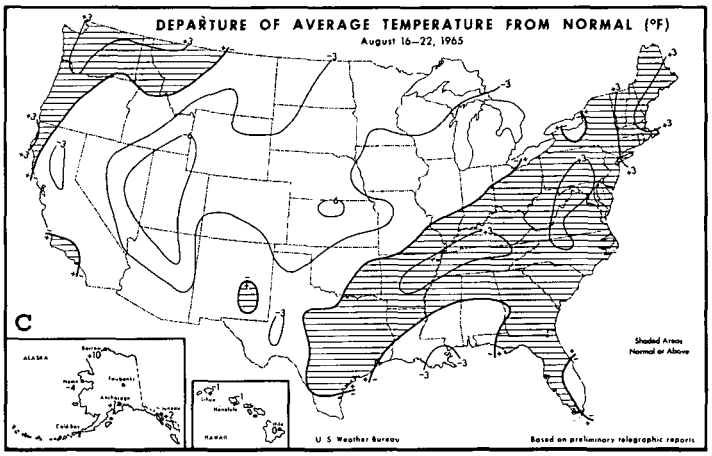
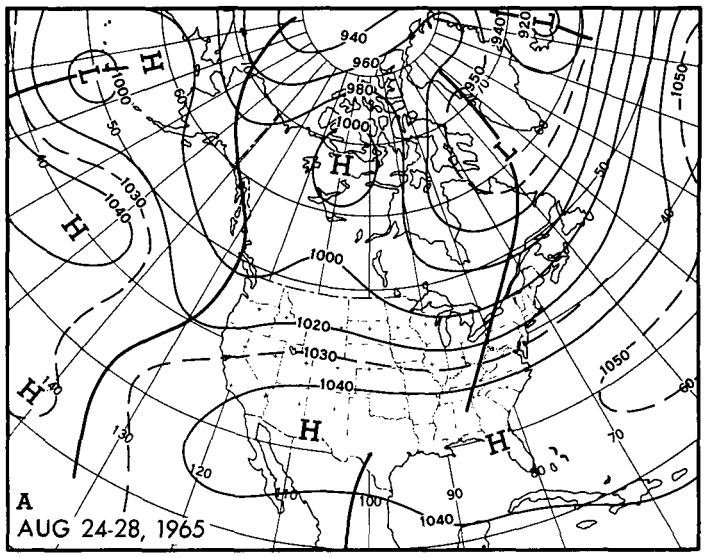
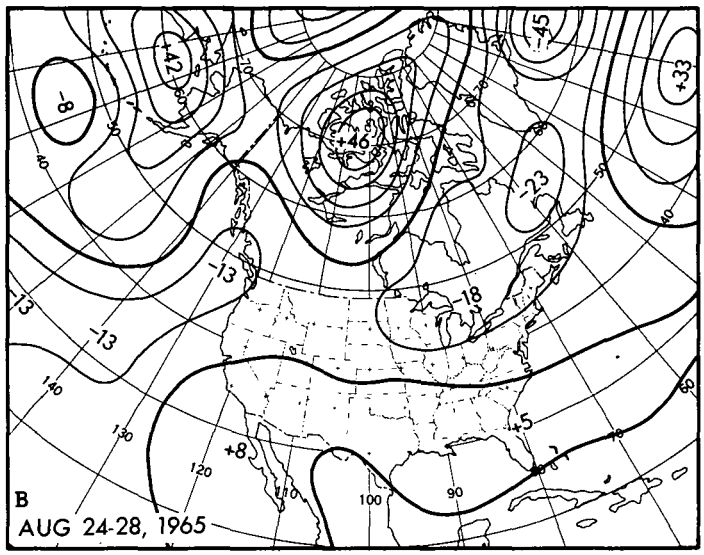


FIGURE 8.—(A) Mean 700-mb. contours and (B) height departures from normal, both in tens of feet, for August 17–21, 1965; (C) departure of average temperature from normal (°F.), August 16–22, 1965 (from [2]).





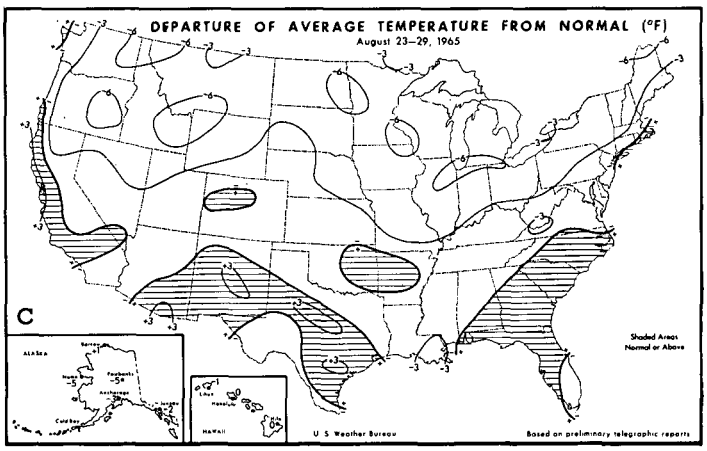


FIGURE 9.—(A) Mean 700-mb. contours and (B) height departures from normal, both in tens of feet, for August 24–28, 1965; (C) departure of average temperature from normal (°F.), August 23–29, 1965 (from [2]).

with the approach of long-wave troughs, and thunderstorm activity was widespread in the South.

AUGUST 16–22

Blocking returned the third week as a ridge built rapidly in western Canada and the next ridge downstream lost much of its amplitude (figs. 8A, B). Near the west coast the long-wave trough continued to fill and progress while the eastern trough intensified. As the Atlantic High moved northeastward the easterly flow south of it increased and the circulation became very favorable for the formation of tropical cyclones.

Weekly temperatures were again below normal in a wide band from the Southwest to the Northern Plains and the Great Lakes but remained above normal in the East. It was unusually rainy along and north of the frontal zone which roughly paralleled the boundary between contrasting temperature anomalies (fig. 8C). Weekly totals ranged locally to more than 4 in. in Kansas and Missouri, and additional rain fell in the Northeast drought area. It rained every day in the vicinity of an upper Low near the central Gulf Coast where some weekly amounts were more than 6 in.

AUGUST 23–29

During the last week the High in western Canada continued to move northeastward and remained strong while the eastern trough progressed except near the Great Lakes (figs. 9A, B). The trough along the California coast retrograded leaving little amplitude in the westerly flow across the United States. Negative height anomalies associated with Canadian blocking were zonally oriented acrosss the northern States. In the favorable circulation of the Atlantic tropical storms Anna and Betsy were discovered.

Average temperatures in the northern States were kept well below normal by successive bursts of continental air from Canada (fig. 9C). The strongest Polar outbreak came late in the month following the vigorous development of an occluding wave cyclone over the Maritime Provinces. As the cold air flooded the East numerous low temperature records for the month of August were broken or equaled as far south as Augusta, Ga.

Active fronts this week accompanied the outbreak of severe storms from Iowa to Ohio, where hail and tornadoes caused the loss of four lives and millions of dollars of property damage. In the East rainfall mostly consisted of brief showers and accumulations were light to moderate.

5. TROPICAL STORMS

Development of tropical cyclones was favored by the circulation in the Pacific as well as the Atlantic. In the western Pacific the subtropical ridge and tropical easterly flow were stronger than normal. Among seven tropical storms which formed there, four became typhoons (fig. 10). Three of the typhoons and a tropical storm recurved to extratropical latitudes and the other typhoon broke up along the China coast. In the eastern Pacific three tropical storms were detected, one of which reached hurricane intensity the last day of the month.

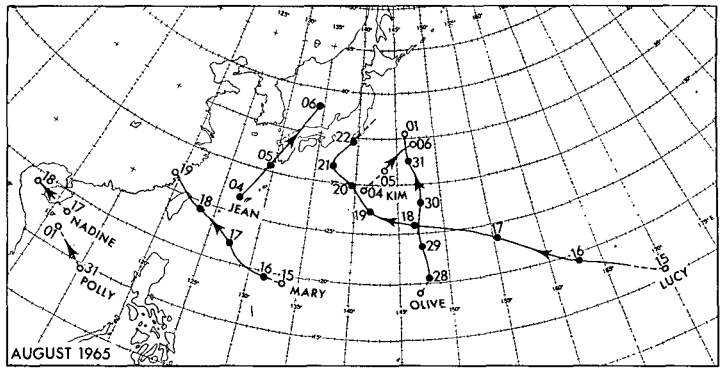


FIGURE 10.—Preliminary smoothed tracks of tropical storms (open circles) and typhoons (solid circles) in the western Pacific during August 1965. Circles with dates indicate 1200 GMT positions.

Formation of tropical cyclones in the Atlantic was encouraged by the northward location of the High with height anomalies positive in the north decreasing to negative in the Tropics. This state of the circulation developed in the latter half of the month, however, and it was not until the final week that tropical cyclones of storm intensity were found in the Atlantic. The first was Anna, already a tropical storm at the time of its discovery southeast of Nova Scotia on the 24th. Anna became a hurricane later that day, then extratropical within two days, and at no time threatened a land area.

Betsy was found in its formative stage the afternoon of August 27 east of the Windward Islands. It traveled rapidly northwestward through the Lesser Antilles with winds of 40 to 55 m.p.h. and reached hurricane strength the 29th about 200 mi. north-northeast of San Juan, P.R. Betsy slowed on the 30th, became stationary on the 31st, then moved slowly and erratically until September 1 when some westward motion was reported.

REFERENCES

1. J. F. Andrews, "The Weather and Circulation of July 1965—A Cool Month Associated with a Large-Amplitude Wave Over North America," *Monthly Weather Review*, vol. 93, No. 10, Oct. 1965, pp. 647–654.
2. U.S. Weather Bureau, *Weekly Weather and Crop Bulletin, National Summary*, vol. 52, Nos. 32–36, 38, Aug. 9, 16, 23, 30, and Sept. 6, 1965.

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